Rose / Shoer

Wavesaver

TRANSIENT WAVEFORM RECORDER

OPERATION MANUAL

Epic Instruments Incorporated

WAVESAVER 10
INSTRUCTION MANUAL

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Epic Instruments Incorporated
Foster City, Ca.94404 U.S.A.
Tel: (415)574-9081
588-2260

2.00 INTRODUCTION:

2.10 General Description:

The Wavesaver 10 is a high speed transient analog and digital waveform storage instrument capable of storing any analog or digital waveform at a maximum real time sampling speed of 10Mhz (100ns). Selectable sweep speeds of 100ns to 80ms allows for flexible selection of the recording rate. In addition to the supplied sweep speeds; the **EXT.CLK** input allows the operator to use any desired externally supplied "clock" to determine the recording rate.

In the pre-trigger mode of recording, occurrences that happened before the trigger signal can be captured; also, a mixing of post-trigger and pre-trigger information can be captured by using the pre-trigger "1/2" mode of operation. As an added feature, the Wavesaver 10 can be "Armed" and "Triggered" by an externally supplied source. The standard parallel output port allows captured data to be easily accessed by most personal and lab type computers. If a direct hard copy is desired, the Wavesaver 10 is capable of driving most popular chart recorders.

***** NOTE ON OPERATION MANUAL *****

Note that throughout this manual the name Wavesaver, Wavesaver 10, Wavesaver 10H and 10 is used in a random manner, please remember that they are the same instrument in all respects.

***** SOFTWARE NOTE *****

Software to transform your IBM PC/XT/AT and compatible microcomputers to perform waveform analysis is available from Epic Instruments. Interfacing hardware from the Wavesaver 10 to the IBM PC's and IBM clone computers is also available, please consult Epic Instruments for more details.

see also page 12-14

2.20 SPECIFICATIONS:

SIGNAL INPUT:

Input Impedance	: 1 megohm/18pf. (approx.)
Input Voltage Range	: +/- 50mv to +/- 10 volts full scale. (In 1,2,5 steps. 8 ranges).
Maximum Input sensitivity	: +/- 50mv (100mv total).
Minimum Input sensitivity	: +/- 10 volts (20v total).
Maximum Input voltages	: +/- 50 volts continuous.
	: +/- 70 volts transient.
Input Coupling	: AC, DC & Ground.
Offset Adjustment	: +/- 1x Input voltage range setting. ("Switched" Zero centering provided).

ANALOG TO DIGITAL CONVERSION:

Vertical Resolution	: 8 bits (256 steps).
A/D Accuracy	: Better than 0.4%.
Max. Digitizing rate	: 10 Mhz, 100ns per sample point.
Converter Technology	: 8 bit parallel technique (Flash).
Recording Rates	: Internal Clock = 100ns to 80ms, (24 ranges).
	: External Clock = 50ns to DC (TTL). Clock symmetry = 60/40% or 40/60%. Note: External clock requires 2x actual sample frequency.

MEMORY:

Memory Size	: 4096 x 8 (Static Ram).
Jitter	: Plus or minus 2 data points at start of record cycle, worst case.

RECORDING MODES:

Post-Trigger	: Starts recording after receiving a trigger and continues until the 4K x 8 memory is filled.
Pre-Trigger (ALL)	: Upon receiving the "ARM" signal, the unit begins the recording cycle; and will continue to record until a trigger is received, and stops. Note that only the last 4096 samples is stored before the trigger occurred, since the depth of the memory is 4096 points.
Pre-Trigger (1/2)	: Fills half the memory with information (data) before the trigger and half after the trigger. A mixing of both pre and post trigger data; (2K before the trigger occurred and 2K after).

See also pages 12-14
24-26

TRIGGERING:

Internal : Preset desired level with "Trig-Level" potentiometer. Tracks +/- VOLTS attenuator. Selectable positive or negative slope. Range is 1x +/- VOLTS attenuator.

External : Via rear panel 15 pin "D" connector, TTL levels only. Note that the +/- trigger slope selector is also active when this input is used.

Manual : Front panel pushbutton switch.

ARMING:

Manual : Front panel pushbutton switch.

External : Via rear panel 15 pin "D" connector, TTL levels only; active "LOW" pulse required.

Auto : Unit will arm itself after the first display period (one memory dump period) has occurred.

Memory Dump Time to ARM : Internal playback Clock = 10 ms.
: External Clock at 10Mhz = 410 us.

OSCILLOSCOPE & PLOTTER OUTPUTS:

Vertical Output : Min = 0 volts, Max = 8 volts.
: Most negative = 0 volts (00000000) (0).
: Mid scale(0v) = 4 volts (10000000)(127).
: Most positive = 8 volts (11111111)(255).

Horizontal Output : Oscilloscope trigger pulse.

Plotter : Analog output rate is slowed to allow the use of mechanical pen plotters; or the data (in analog form) can also be clocked out (single stepped) using an external clock source.

DIGITAL DATA OUTPUTS:

(1) 8 BIT PARALLEL DATA: Output is word serial.

(2) EXTERNAL RECORD GATING: Start/stops recording cycle, TTL levels only; "LOW" level halts recording.

(3) SYNC IN: Used usually for synchronizing multiple units, TTL levels only. Active "LOW" input.

(4) SYNC OUT: Used usually for synchronizing multiple units, TTL levels only. "LOW" level output pulse.

(5) EXTERNAL ARM: Duplicates "ARM" pushbutton, TTL levels only. Active LOW input pulse required.

(6) EXTERNAL TRIGGER: Duplicates "TRIGGER" pushbutton, TTL levels only. Active LOW or HIGH, edge sensitive, determined by +/- Trigger Slope Pushbutton.

(7) EXTERNAL READ CLOCK: User supplied clock to step data out of Wavesaver (data request), TTL levels only.

GENERAL:

Operating Temperature	:	35F. to 95F.
Power Requirements	:	(1) 108vac to 125vac @ 10W, 50-60Hz.
		(2) 216vac to 250vac @ 10W, 50-60Hz.
Fuse Requirements	:	For 117vac range use 0.25A. 3AG FB.
		For 220vac range use 0.125A. 3AG FB.
Physical Size/Weight	:	Length = 11.6 inches.
		Width = 12.6 inches.
		Height = 5.5 inches.
		Weight = 5.0 pounds (approx.).

MISCELLANEOUS & GENERAL SAFETY:

(A) Published specifications apply at 72F. After 30 minutes warmup.

(B) This Instrument is wired for earth ground via the third (round) prong of the power (AC) plug. Do not bypass or defeat earth grounding by any method.

(C) Before "plugging in" the instrument, please read this manual carefully.

(D) Maintenance may require the power to be on and with the the plastic cover(s) removed. This should only be performed by qualified personnel aware of electrical hazards.

(E) The instrument's case is made of high grade ABS plastic, and no exterior maintenance is required except for an occasional cleaning. It is not a "waterproof" enclosure, so no "bathing" should ever be performed.

3.00 OPERATIONS:

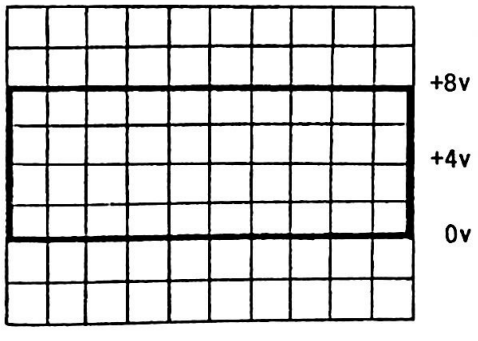
The Wavesaver 10 is basically an oscilloscope "add-on" which will give digital storage capabilities to any oscilloscope. Effectively transforming a regular oscilloscope into a high speed digital storage scope; and with the added feature of being able to interface and transfer its captured data to most personal and lab type computers.

Being a digital instrument, the Wavesaver 10 does have some differences when compared with regular analog storage oscilloscopes. The main difference is that an analog storage scope holds the captured waveform usually by "burning in" the trace onto the CRT itself and the Wavesaver holds the recorded data in its own digital memory, thus adding the flexibility of being able to extract the information recorded and thereby allowing a more precise examination of the captured data.

The Wavesaver 10 converts defined sample points of an analog waveform and converts these points into their digital equivalent codes, these codes are then stored in it's internal memory. After the memory is filled, these codes are then reconverted back into their analog equivalents and is then continuously played back on the oscilloscope; thus transforming a regular oscilloscope into a storage scope but with none of the "undesirable" features, such as the "blooming" and "fading" effect that is inherent and common in most analog type storage oscilloscopes.

3.10 INTERPRETING THE DISPLAY:

With the recommended setup for the oscilloscope (1ms per division for the horizontal sweep rate and 2 volts per division vertical deflection); the Wavesaver 10 will display its full 4K x 8 memory on the oscilloscope. With this setup, the full horizontal width and exactly four divisions vertically will be utilized as the display area on the oscilloscope.



NOTE:-

(1) Standard Settings. (Display Area)
(2) Vertically = 4 div.
(3) Horizontally = 10 div.

Fig. 3.10 - 1

With these standard settings, the recorded waveform will never exceed the area as shown in Fig 3.10-1. If the input signal exceeds the digitizing range (an overange condition), the waveform displayed will show up as "flat spots" wherever an overload occurs.

3.20 WAVEFORM FREQUENCY:

Interpreting the recorded waveform is simple and varies little from reading the display of an ordinary oscilloscope. Always remember that the Wavesaver 10 has a 4K x 8 memory and it samples at defined intervals determined by the "Time-Per-Point" switch or a user supplied clock via the "EXT.CLK" input.

From this point on, the recommended scope settings of 1ms per/div horizontally and 2 volts per/div vertically will be used for all examples given; and will be referred to as the "standard settings". Remember that the full 4K bytes of memory will be displayed per sweep when the standard settings are used.

The scope, when used with the Wavesaver 10, is really being used as a display and not used like one would usually use a scope; as the interpretation of the recorded waveform is really a relationship between the setting of the "Time-Per-Point" switch on the Wavesaver 10 when the recording was made, and the 4K bytes of memory. For example: If a recording was made at a TPP setting of 1us per point, the duration of the entire memory sweep will be 4096 x 1us = 4096us; or 4.096ms, therefore each of the 10 horizontal divisions on the Scope is 4.096ms/10 = 409.6us or simply 400us wide.

The chart on the following page shows the relationships between the TPP switch setting, the Horizontal divisions on the oscilloscope and the duration (or complete sweep length) of the 4K bytes of memory for the particular TPP setting. The user should be aware that since over 400 "data points" will be compressed into one scope division, and if the captured data is closely packed; the user should use the "x10" expansion or the so called "mixed-mode" function available on most oscilloscopes to enable a more precise examination of the captured data.

	TIME PER POINT	TOTAL SWEEP TIME	PER SCOPE DIVISION
(1)	100 ns	409.6 us	40.96 us
(2)	200 ns	819.2 us	81.92 us
(3)	400 ns	1.6384 ms	163.84 us
(4)	800 ns	3.2768 ms	327.68 us
(5)	1 us	4.096 ms	409.6 us
(6)	2 us	8.192 ms	819.2 us
(7)	4 us	16.384 ms	1.6384 ms
(8)	8 us	32.786 ms	3.2768 ms
(9)	10 us	40.96 ms	4.96 ms
(10)	20 us	81.92 ms	8.192 ms
(11)	40 us	163.84 ms	16.38 ms
(12)	80 us	327.68 ms	32.768 ms
(13)	100 us	409.6 ms	40.96 ms
(14)	200 us	819.2 ms	81.92 ms
(15)	400 us	1.638 sec	163.84 ms
(16)	800 us	3.277 sec	327.68 ms
(17)	1 ms	4.96 sec	409.6 ms
(18)	2 ms	8.192 sec	819.2 ms
(19)	4 ms	16.384 sec	1.6384 sec
(20)	8 ms	32.768 sec	3.2768 sec
(21)	10 ms	40.96 sec	4.96 sec
(22)	20 ms	81.92 sec	8.192 sec
(23)	40 ms	163.84 sec	16.38 sec
(24)	80 ms	327.68 sec	32.768 sec

Fig. 3.20 - 1

The above chart shows the relationship between the setting of the Time-Per-Point switch and the horizontal divisions on a regular oscilloscope. Note that the normal ten divisions that is on most scope grids is assumed. Also the scope's variable sweep control is used to compress the entire 4096 bytes into the 10 divisions. The user should always remember that the Wavesaver 10 has a 4Kx8 memory and it samples at defined intervals determined by the setting of the Time-Per-Point switch; therefore the length of each sweep is:-

Length of sweep = 4096 x (setting of TPP switch)

Example: TPP at 20us.
Length of sweep = 4096 x 20us = 81.92ms
Each scope Div. = 81.92us / 10 = 8.192ms

From the previous explanation and examples one can see that from the timing chart (Fig. 3.20-1); the values of the "Per-Scope-Division" is somewhat difficult to use because of the odd values that is obtained when 4096 bytes of data is being displayed on an oscilloscope with 10 equal horizontal divisions. Therefore we have chosen a display rate of 400Khz or 2.5us per display point; which, as we will show would enable a much easier interpretation of any time related measurements on an oscilloscope.

A display frequency rate of 2.5us per sample point with 4096 bytes of data to display is equal to exactly 10.24ms per sweep, and since there are 10 horizontal divisions on the oscilloscope; and the horizontal sweep speed on the oscilloscope is set at 1ms per division; there will be a "spillover" or "over-sweep" of 0.24ms, which is equal to 96 bytes. Therefore exactly 4000 data points will occupy the 10 horizontal divisions, and 400 data points occupies each division. With exactly 400 points per division, one can visualize that it is much easier to interpret time related measurements. If the last 96 points is of interest, the operator can use the horizontal position control on the scope to move the trace slightly to the left and examine the 96 bytes under a grided division.

The explanation and Fig.3.20-1 was included for clarity and can be realized if the horizontal sweep of the scope is set for 1ms per division and if the variable sweep control on the oscilloscope is used to compress the entire sweep of the Wavesaver into the ten grids. But for all practical purposes the scope should be set for 1ms (calibrated) and the horizontal position control is used to measure the last 96 data points if required.

IN SUMMARY:

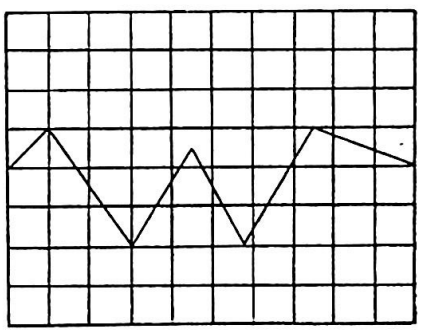
(1) The Wavesaver's scope output frequency rate is constant at 400Khz, and therefore the total output sweep time is 10.24ms (4K Memory).
(2) When the scope is set at 1ms per/div, an over-sweep of 96 data points exists and 400 data points will occupy each scope division.
(3) No matter what TPP setting a waveform was recorded at, the Wavesaver's scope output rate is always constant at 400Khz.

3.30 WAVEFORM VOLTAGE LEVEL:

To measure or read the recorded voltage level, always refer to the setting of the +/-VOLTS switch which it was recorded at. The setting on the oscilloscope has absolutely no relationship to the actual level being displayed. Because, after the data is stored into memory; the digital codes are reconverted back into analog form and the output of the D/A converter is constant throughout all the range settings of the +/-VOLTS switch. In other words if a sine wave with a level of +/-2 volts was recorded at the +/-VOLTS setting of +/-2 volts, the sine wave would fill the entire vertical display area on the scope. If one was to measure the exact voltages coming out of the Wavesaver 10, the levels would be a voltage swing of 0 to 8 volts. Now take a +/-50 mv sine wave and record it at a setting of +/-50 mv on the Wavesaver 10, the voltage level coming out of the Wavesaver 10 is also 0-8 volts.

In Other Words:-

(1) The analog output of the D/A converter is always fixed at 0-8 volts.
(2) The vertical display area on the scope is a ratio of the +/-VOLTS setting on the Wavesaver 10.
(3) To read the recorded voltage level(s), the +/-VOLTS switch must be referenced.
(4) The oscilloscope's voltage attenuator has no relation as to the actual level being displayed.
(5) The 0-8 volts is always a ratio of the +/-VOLTS switch setting the waveform was recorded at.
(6) Switching the +/-VOLTS range on the Wavesaver 10 after the recording cycle has no effect on the output levels.



Wavesaver Setting:-
+/-VOLTS = +/-5 volts

Scope Setting:-
Standard settings.

Waveform:-
Maximum = +2.5 volts
Minimum = -5.0 volts

Fig. 3.30 - 1

IN CONCLUSION:

To measure/read the recorded level, always refer to the "level" it was recorded at, changing the setting on the +/- VOLTS switch during the display period would not change the "size" of the displayed waveform. Remember that the level coming out of the Wavesaver 10 is always 0 to 8 volts. Application of voltages greater than the selected range would only result in a "flattening out" of the portion exceeding the level selected. This will not damage the Wavesaver 10 if the maximum input level specified (+/- 50v) is not exceeded, but should be an indication to the user to select a more appropriate range.

Note again that the output range is 0 to 8 volts, which means that actual "0" level is really an offset level of +4 volts. The settings on the +/-VOLTS attenuator is set for FULL SCALE and is not for each scope division; in other words, if the +/-VOLTS selector is set for +/-2 volts, it means +/-2 volts for all four vertical divisions (0.5 volts per division).

IN RELATION: DIGITALLY:-

MSB	LSB				
1 1 1 1 1 1 1 1	=	255	=	+8 volts.	(Most Positive).
1 0 0 0 0 0 0 0	=	127	=	+4 volts.	("0" Point).
0 0 0 0 0 0 0 0	=	0	=	0 volts.	(Most Negative).

See also pages 3,4

4.00 CONTROL SWITCHES / INPUTS & OUTPUTS:

4.10 FRONT PANEL DESCRIPTION:

PUSHBUTTON SWITCHES:

(1) ALL / 1/2 : Selects between "ALL" Pre-Trigger data or half Pre-Trigger and half Post-Trigger data.
(2) POST / PRE: Selects either "Post" or "Pre" Trigger.
(3) + / - : Selects either positive or negative trigger slope.
(4) INT / EXT : Selects between Internal or External trigger.
(5) ARM : Momentary Push switch, push to ARM Wavesaver.
(6) TRIG : Momentary Push switch, push to TRIGGER Wavesaver.
(7) AUTO / MANUAL : Selects between "AUTO" arming or "MANUAL" arming.
(8) uSEC / mSEC : Selects TIME-PER-POINT rotary switch for microsecond or millisecond ranges.
(9) INT.CLK / EXT.CLK : Selects between INTERNAL clock or EXTERNAL clock.
(10) OFFSET / CENTER : Select "OFFSET" to enable offset potentiometer, "CENTER" to disable offset potentiometer and zero center scale.

ROTARY SWITCHES:

TIME PER POINT : Selects the A/D's sampling speed.
+/-VOLTS : Input voltage attenuator, note that scales are "Full Scale". Please also note that the level is +/- of setting (eg. The +/-50mv range is actually +50mv & -50mv which equals 100mv total).

TOGGLE SWITCHES:

POWER : Supplies AC power to Wavesaver 10.
DC/GND/AC : Selects input signal to be either AC or DC coupled. GND position grounds input circuit for calibration purposes and disconnects the input signal to the Wavesaver 10.

MISCELLANEOUS:

INPUT (BNC) : Signal Input Jack.
TRIG-LEVEL POTENTIOMETER : Sets Internal trigger level.
OFFSET POTENTIOMETER : Sets offset level, disable with pushbutton switch "OFFSET/CENTER".

See also page 3,4
24-26

4.20 REAR PANEL DESCRIPTION:

Most of the "control" switches is located on the front panel except for the "SCOPE or PLOT" selector toggle switch which is located on the rear panel. The rear panel consist mainly of the data interfaces and the "BNC" connectors.

(1) SCOPE/PLOT (toggle switch) : Selects between either the internal clock for displaying the captured waveform on an oscilloscope. Or if the "PLOT" position is selected; an external clock can be applied to drive a peripheral such as a plotter or chart recorder.

(2) EXT.CLK (BNC Connector) : Input for external "record" or "write" clock. The maximum input frequency is 20 Mhz and only a TTL signal should be used.

(3) OUTPUT (BNC Connector) : Vertical (Y) output. Analog output to drive either an oscilloscope or a plotter.

(4) TRIGGER (BNC Connector) : TTL level output pulse used for triggering the oscilloscope or can be used for sync purposes.

(5) FUSE : Fuse used depends on AC voltage. Use a 1/2A.FB for 117vac operation or a 1/4A.FB for 220vac.

(6) AC POWER : AC power input, 108vac - 250vac, selectable.

(7) DATA CONNECTOR (15 pin "D" connector) :-

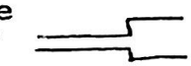
Pin (1) = Data out - Least significant Bit (1):(LSB).
Pin (2) = Data out - Second data bit. (2).
Pin (3) = Data out - Third data bit. (3).
Pin (4) = Data out - Fourth data bit. (4).
Pin (5) = Data out - Fifth data bit. (5).
Pin (6) = Data out - Sixth data bit. (6).
Pin (7) = Data out - Seventh data bit. (7).
Pin (8) = Data out - Most Significant Bit (8):(MSB).
Pin (9) = SIGNAL GROUND.

see also pages 3,4
24-26

Pin (10) = External Gating:- Starts or stops recording, Starts = HIGH (open), Stops = LOW.

Pin (11) = Sync In:- Synchronizing signal. Application of a LOW level resets memory to beginning of record position (home). (beginning of memory)

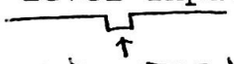
Pin (12) = External Trigger Input:- To "trigger" the Wavesaver with an external source. edge +/-



* Pin (13) = External Read Clock:- External clock to step the stored data out. Usable for both analog and digital output formats. edge, +

Pin (14) = Sync Out:- Synchronizing output signal, pulsed output signal.

Pin (15) = External Arm:- A LOW level input arms the Wavesaver. level, low



(make sure pulse stays low long enough)

***** NOTE *****

Only TTL level signals should be used with the Wavesaver 10, otherwise damage might result. The minimum and maximum level of the analog "OUTPUT" is from 0-8 volts, if this is to be connected to monitors that only accepts low level inputs, please consult factory. All other outputs of the Wavesaver 10 are TTL level signals.

The 15 pin connector used is a standard 15 Pin type "D" connector which is made by various manufacturers. It's in the same family as the 25 pin "D" connector used for the RS-232 interface.

* after trigger, first byte available
after trigger, first + edge strobes second byte to output port

4.30 PREPARATION FOR USE:

The Wavesaver 10 may be connected to any suitable AC power source ranging from 108vac to 250vac. For display of the recorded waveform, an oscilloscope or CRT waveform monitor with an external trigger input is required.

NOTE:- Two BNC to BNC connecting cords (not supplied) is required for hookup to the oscilloscope. A signal probe is also required for input to the Wavesaver.

***** PLEASE READ THIS SECTION CAREFULLY BEFORE *****
APPLYING AC POWER TO THE WAVESAVER 10

(1) If this is a first time startup, make sure that the AC operating voltage is correct for the location of operation.

(2) Make all necessary connections from the Wavesaver 10 to the oscilloscope. The rear panel BNC marked "OUTPUT" should be connected to the vertical input of the oscilloscope. The rear panel BNC marked "TRIGGER" should be connected to the external trigger input of the scope.

(3) Set up the oscilloscope as follows:-
(A) Horizontal Sweep speed at 1ms per division.
(B) Vertical attenuator at 2 volts per division.
Note that when the sweep speed is at 1ms per/div, the full 4K bytes of memory will be displayed in one sweep. With the vertical at 2 volts per/div, this will yield a full scale deflection of 4 divisions on the oscilloscope. Therefore the display area will be 10 divisions horizontally and 4 divisions vertically. These are considered the "standard" settings for the Wavesaver 10 and will be used throughout this manual.

(4) On the Wavesaver 10 use the following positions for the control switches:-
(A) ALL / 1/2 = Don't care, either position.
(B) POST / PRE = POST trigger position.
(C) + / - = "+" position.
(D) INT / EXT = INT position.
(E) AUTO / MAN = AUTO position.

(F) uSEC / mSEC = uSEC position.
(G) INT / EXT CLK = INT CLK position.
(H) OFFSET/CENTER = CENTER position.
(I) DC / GND / AC = GND position.
(J) TIME PER POINT = 1 uSEC per point position.
(K) OFFSET (potentiometer) = Don't care.
(L) TRIG-LEVEL (potentiometer) = Mid-Scale.
(M) +/- VOLTS = +/- 50mv position.
(N) SCOPE / PLOT (Rear Panel) = SCOPE position.

(5) Recheck all connections from the Wavesaver 10 to the oscilloscope, and apply AC power to both instruments.
(6) When the oscilloscope trace appears. Slowly rotate the TRIG-LEVEL potentiometer left and right from center scale until the Trig-Level L.E.D. begins to blink briefly (this initiates a record cycle). Now center the the trace on the scope on "mid" or "0" scale. This in effect calibrates the scope's trace with the Wavesaver 10's output amplifier.
(7) Switch "DC / GND / AC" toggle switch to "DC" position.

***** NOTES *****

Under certain conditions on initial power up, a "scrambled" display might be visible on the scope's screen, this is a normal condition since the memory of the Wavesaver has not been properly reset after "power-on". To reset the Wavesaver, simply place the "DC / GND / AC" switch to "GND" and put it through a record cycle; this in effect clears the 4K x 8 memory to a "0" state.

If the display is "jittery" or unstable, adjust the trigger level on the oscilloscope for a stable display.

memory reset

5.00 OPERATING THE WAVESAVER 10

The operation of the Wavesaver 10 consists mainly of two different "modes" or functions. One is the "PRE-TRIGGER" mode and the other is the "POST-TRIGGER" mode. They differ mainly in "when" the unit triggers and how the data is stored and displayed. In the Pre-trigger mode, the Wavesaver has the ability to capture data before the trigger occurs. In the Post-trigger mode, the Wavesaver begins to record after detecting the trigger and stops after the 4K memory is filled.

All the control switches and data/control lines can be utilized in the Pre-trigger mode of operation. In the Post-trigger mode, only the "1/2 / ALL" push switch is not used and is not active in the Post-trigger mode.

Before Continuing:-

If not done so already, please read the previous sections on the interpretation of the waveform frequency (3.20), voltages (3.30); and also the portion on the explanation of the control switches (4.10 & 4.20) before continuing.

5.10 POST-TRIGGER OPERATION:

In the Post-trigger mode, the Wavesaver resembles a regular analog storage oscilloscope. The waveform or signal is stored after first detecting the trigger; and in the case of the Wavesaver, the recording terminates after the 4K x 8 memory is filled.

For the following operating example, the following additional equipment is required:-

(1) OSCILLOSCOPE (With External Trigger Input).
(2) FUNCTION GENERATOR (With Triangular Output).
(3) 3 (BNC to BNC) CORD SETS (Connecting Cords).

Connect one cord set from the vertical output of the Wavesaver to the scope's vertical input channel. Connect another cord set from the "TRIG"(BNC) output of the Wavesaver to the scope's external trigger input.

The setup for the Wavesaver as described in section 4.30@(4) must be used for this demonstration. Recheck connections to both instruments and adjust the function generator to supply a triangular waveform at 1Khz and an output level of +/-50mv. If a triangular waveform is unavailable, a sine wave or any other "repetitive" type of waveform can be used, but do not use a square wave as it does not demonstrate well the full capabilities of the Wavesaver 10.

(1) Set up the Wavesaver, Oscilloscope and function generator as described in the previous paragraphs. Turn all three instruments "ON" and connect the function generator to the Wavesaver.

(2) TIME-PER-POINT selector should be set to supply 1us per point. The +/-VOLTS should be set at +/-50mv full scale.

(3) Select signal to be "AC" coupled (DC/GND/AC toggle switch). Trig-Level potentiometer should be set for "mid-scale" or "0" position.

(4) The "AUTO/MAN" push switch is set at manual (MAN).

(5) The Wavesaver 10 is now ready to store waveforms.

(6) Depress the ARM pushbutton. The applied signal should now be visible on the CRT of the oscilloscope. If the displayed waveform appears unstable, adjust the trig-level on the scope for a stable display.

(7) Change the function generator to output another frequency, depress the ARM switch; the new wave-shape should instantly replace the previously recorded waveform.

(8) Now put the Wavesaver 10 in the "AUTO" arming mode (AUTO/MAN Pushbutton). The Wavesaver will now toggle between the record and display cycles. Try varying the input frequency, note that the the "AUTO" mode places the Wavesaver in a semi-real-time mode.

Experiment recording different waveforms, frequencies and voltages to get a "feel" in which the Wavesaver 10 functions in the Post-trigger mode. An interesting way is to use an ordinary audio microphone connected to the Wavesaver 10; adjust the T.P.P. for the most appropriate sampling rate that gives the best display on the oscilloscope. Also adjust the +/-VOLTS switch and the TRIG-LEVEL potentiometer to match the output level of the microphone being used.

***** NOTE: *****

The user have probably noticed that when the input signal exceeds the range setting of the +/-VOLTS switch, either the top or bottom points of the waveform exceeding the range setting will "flatten out", this is a normal condition since the Analog to Digital converter in the Wavesaver is at an overload condition.

5.20 PRE-TRIGGER OPERATION:

The Pre-Trigger function allows the Wavesaver 10 to capture waveforms before the trigger occurs. Functionally there are two basic methods or modes the Wavesaver can operate in: (1) The ALL mode and (2) The 1/2 mode. The ALL mode is the utilization of "all" the memory in the Wavesaver to record data before the "trigger" occurred. The 1/2 mode dedicates half the memory for data before the trigger and the other half of the memory for data after the trigger; this, in effect, will yield a recording that contains data that happened before the trigger and after the trigger.

For the following operating example, the following additional equipment is required:-

(1) OSCILLOSCOPE (With External Trigger Input).
(2) FUNCTION GENERATOR (With Triangular Output).
(3) 3 (BNC to BNC) CORD SETS (Connecting Cords).

Connect one cord set from the vertical output of the Wavesaver to the scope's vertical input channel. Connect another cord set from the "TRIG"(BNC) output of the Wavesaver to the scope's external trigger input.

The setup for the Wavesaver as described in section 4.30@(4) must be used for this demonstration. Recheck connections to both instruments and adjust the function generator to supply a triangular waveform at 1Khz and an output level of +/-50mv. If a triangular waveform is unavailable, a sine wave or any other "repetitive" type of waveform can be used, but do not use a square wave as it does not demonstrate well the full capabilities of the Wavesaver 10.

(1) Set up the Wavesaver, Oscilloscope and Function Generator as described in the previous paragraphs. Turn all three instruments "ON" and connect the function generator to the Wavesaver.

(2) Select the PRE/POST trigger switch for PRE-TRIGGER.

(3) TIME-PER-POINT selector should be set to supply 1us per point. The +/-VOLTS selector switch should be set at +/-50mv full scale.

(4) Select input signal to be "AC" coupled (DC/GND/AC toggle switch). Trig-level potentiometer should be set for "mid-scale" or "0" position.

(5) The "AUTO/MAN" push switch is set at manual (MAN).

(6) The "INT/EXT" push-button should be set for "EXT".

(7) The "1/2 & ALL" push-button should be set for "ALL".

(8) Depress the ARM switch, the display as viewed on the oscilloscope should appear to be out of sync, this is normal since the Wavesaver is actually digitizing the input waveform and will continue to do so until it detects a trigger.

(9) Depress the manual TRIG push-switch, the recording will immediately stop and the Wavesaver will switch from the record mode to the display mode. Note that the data (waveform) displayed happened before the trigger and that the "trigger" is located on the right (end) of the display. This is the Pre-Trigger "ALL" mode. The Wavesaver will remain in the display mode until another ARM signal is received.

Try using the microphone and experiment recording different sounds. Use the INTERNAL TRIGGER and the AUTO ARM feature to make recordings. Try the Pre-Trigger 1/2 mode; it operates in the same way as the ALL mode and only differs in the way that 2K of memory is used to record Pre-Trigger data and 2K is used to record Post-Trigger information; the 1/2 mode will place the trigger point in the middle of the display, enabling viewing "before" trigger and "after" trigger information.

***** NOTE ON PRE-TRIGGER RECORDING *****

During Pre-Trigger recording, if the trigger occurs before the entire sweep of the memory; the resulting display might include a certain part of the previously recorded waveform. To alleviate this condition, the entire memory should first be "cleared" if the next recording cycle is known to be shorter then the 4K memory length; or if the trigger will present itself before the 4K of memory is cycled once (written over).

To erase the memory, simply "ground" the input amplifier on the Wavesaver (DC/GND/AC switch); now place the External Trigger switch in the "EXT" position. ARM the Wavesaver, after the "time" (4096 x Setting of TPP switch) have elapsed, the memory will be completely erased. The signal coupling and trigger select switches should be returned to their desired positions after erasing.

6.00 INTERFACING WITH A PLOTTER/CHART RECORDER:

The SCOPE/PLOT switch is used to switch the analog output frequency rate between the oscilloscope and the plotter. The difference between the two is that when the oscilloscope (SCOPE) rate is selected, the playback rate is preset at 400Khz. If the Plotter is selected, an external TTL clock must be supplied and used (15 pin D connector, Pin 13) to step the data out of the Wavesaver.

If the plotter being used requires an external initializing signal, the "TRIG-OUT" signal can be used.

6.10 USING A LOW CAPACITANCE SIGNAL INPUT PROBE:

When the use of a low capacitance probe is necessary. The probe would have to be matched to the input of the Wavesaver.

Proceed as follows:-

(1) A square wave @ 1Khz is applied to the low capacitance (10:1) probe which is attached to the input of the Wavesaver.

(2) Set the Time-Per-Point switch to display a number of cycles on the oscilloscope. Post-Trigger, Auto Arm, Internal Trigger and DC Coupling should be used.

(3) Set the +/-VOLTS selector to match the input signal level being applied (Do not overload). Adjust the probe until the square wave "squares up".

***** NOTE *****

Please note that due to the "record to display time" or "lag-time", a probe adjustment made during the "record period" will not show up until the display period.

7.00 THE DIGITAL DATA INTERFACE:

The Digital Interface allows users of the Wavesaver 10 to extract the digitized waveform in digital form. It also allows the user to externally ARM, TRIGGER and GATE the Wavesaver. Pins 1 thru 8 are the data output pins with pin 1 being the least significant bit (LSB); and pin 8 the most significant bit (MSB). Pin 9 is the signal ground and should always be connected, otherwise improper data transfer might occur. Pin 10 is the external "GATE" input, if a low level TTL signal is applied to this point, the recording will stop; and will remain in this standby condition until the "Low" is removed or brought "High". Pin 11 is the Sync-In signal and is used for synchronizing multiple units; it can also be used as an input to reset the display to it's "Starting point" or "Home" position. Pin 12 is the External Trigger input. Pin 13 is the External Read Clock, it is used in conjunction with the "Scope/Plot" switch to clock the data out at a user selected rate. Pin 14 is the Sync-Out output pin, the signal is a compliment to the "Trig-Out" BNC connector. Pin 15 is the External Arm input.

CAUTION:-

(1) All signals to the data connector MUST be TTL levels, otherwise damage will result. Pins 1 thru 8 & 14 can each drive 10 74Ls loads.

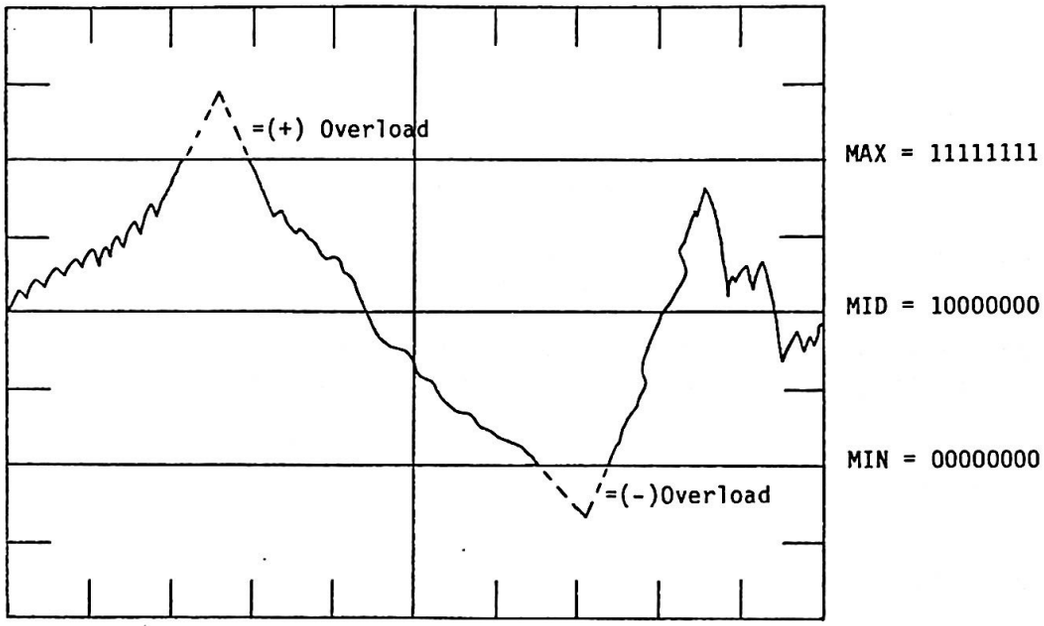
(2) If the PLOT function is used, the data output rate will depend on the externally supplied clock.

15 pin "D" Connector Pinouts:-

Pin 1 Thru 8 = Data output Pins.
Pin 1 = LSB (Least Significant Bit).
Pin 8 = MSB (Most Significant Bit).

Pin 9 = Digital Ground.
Pin 10 = External Gate (Input).
Pin 11 = Sync-In (Input).
Pin 12 = External Trigger Input (Input).
Pin 13 = External Read Clock (Input).
Pin 14 = Sync-Out (Output).
Pin 15 = External Arm (Input).

See also pages 13-14



Note that the above diagram shows that midscale is 10000000, most positive is 11111111 and most negative is 00000000. Be aware that the Wavesaver cannot exceed these ranges. When a positive(+) overload condition occurs, the overload will show up as code 11111111 and a flattening-out of the waveform when viewed with an oscilloscope. A negative overload will have the same effect on the negative side.

IN SUMMARY:-

MSB LSB

1 1 1 1 1 1 1 1 = (255) : Represents most positive point.

1 0 0 0 0 0 0 0 = (127) : Mid-scale.

0 0 0 0 0 0 0 0 = (0) : Represents most negative point.

See this page 13-4

pin **IN SUMMARY:-**

(1) Only TTL levels are to be used.

10 (2) The External "GATE" allows the recording cycle to be gated (turned on and off during a recording cycle).

11 (3) The SYNC-IN Input (If held in a LOW state) resets the memory counters to their original or "begin" position.

13 (4) The EXTERNAL READ CLOCK is a user supplied signal, and enables the user to clock the data out at any rate up to 6 Mhz.

(5) The SYNC-OUT output signal is compliment signal to the TRIG-OUT (BNC) pulse.

12 (6) The EXTERNAL TRIGGER INPUT can be activated by either a positive or negative going TTL pulse, depending on the selection of the "+/- Pushbutton".

15 (7) The EXTERNAL ARM INPUT triggers on the positive going edge of the pulse.

(8) The Sync-In and Sync-Out is usually used for multiple unit operation.

8.00 WARRANTY:

Epic Instruments Inc. warrants that its Wavesaver products to be free of defects in materials and workmanship for six months after the date of customer purchase. Epic Instruments will replace, or repair, at its option, any equipment or accessories which is found to be defective under this warranty. This warranty does not cover any damage caused by negligence, abuse, tampering or modifications performed by the user or customer.

To obtain service under this warranty, all products to be repaired must be returned to Epic Instruments or its authorized distributor from which the product was purchased. No product will be accepted for repair or service unless accompanied by a "Return of Merchandise Authorization" number; which may be obtained by writing or calling Epic Instruments at:-

551-G Foster City Blvd.,
Foster City, Ca. 94404.
Tel: (415)574-9081

***** NOTE *****

This Express warranty is in lieu of all other Warrantys, expressed or implied. Epic Instruments Inc.'s liability shall be limited to the replacement cost of it's own product in question. In no event, and under no circumstances shall Epic Instruments be liable for any direct, incidental or consequential damages arising from failure of it's equipment or from breach of this warranty. No agent, Distributor, or salesperson has the authority to bind Epic Instruments to any other affirmation, representation or warranty concerning these goods. The terms of this warranty constitute the buyer's sole and exclusive remedy.

8.10 LIFE SUPPORT APPLICATION POLICY:

LIFE SUPPORT APPLICATION POLICY

Epic Instruments Inc. does not recommended the use of its Wavesaver products in any "Life Support Applications" wherein the failure of the Epic Instruments Inc. products would threaten life or make injury probable. Any user of Epic Instruments Inc. products in association with a life support system must obtain prior written consent based upon the assurance of Epic Instruments Inc. that a malfunction of Epic Instruments Inc. products does not pose direct or indirect threat or injury or death, and even if such consent is given shall indemnify Epic Instruments Inc. from any claim, loss, liability, and related expenses arising from any injury or death resulting from the use of Epic Instruments Inc. products in a life support application.